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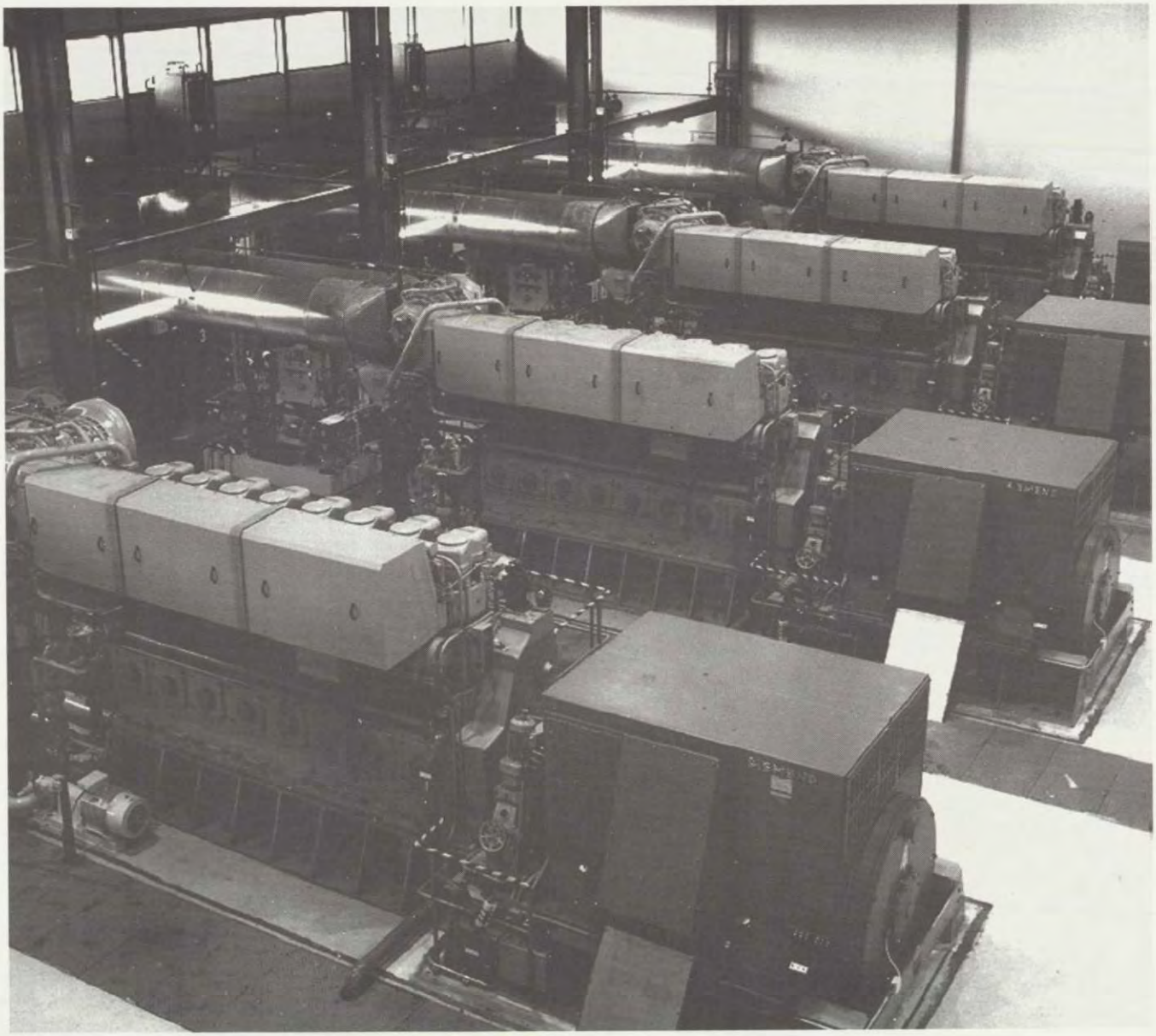
ENERGY SERIES

Improving Electric Power Utility Efficiency

Issues and Recommendations

Christoph Menke and P. Gregory Fazzari



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The World Bank
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Contents

Foreword

Over the past two decades, many publicly owned power utilities in developing countries have performed far below expectations on both operational and financial grounds, despite extensive technical and financial assistance from international agencies.

It was the utilities' continuing poor performance that prompted the World Bank and nine other international aid agencies to initiate an investigation of power plants worldwide in 1988-89. To facilitate the work, the sponsors limited the study to diesel plants, visiting 25 diesel utilities in developing countries and evaluating data from nearly 200 others. The study team observed that the utilities suffered from their governments' lack of clear policies and goals and were hobbled by lack of independence (especially to set financially and economically sound tariffs), lack of authority to pay competitive wages to technically qualified personnel, and inability to maintain proper training, accounting, and bill collection. The detailed findings appeared in the Industry and Energy Department (IEN) "pink" energy series, as "Core Report of the Electric Power Utility Efficiency Improvement Study" (Energy Series Paper No. 46, September 1991).

As part of its mandate, the study's central project team has compiled the present volume of efficiency issues and recommendations designed to assist the officers of energy institutions in developing countries and the personnel of technical and financial aid organizations. For on-site monitoring of utilities' performance, the team has also developed a checklist, presented as an annex and also available separately for field use from IEN. As the team indicates, the recommendations address basic conditions of viability and efficiency and should be seen to supplement rather than supersede the operational directives and appraisal rules of individual organizations.

In addition to treating technical matters, the present volume stresses good governance and institutional and managerial performance as keys to efficiency. This emphasis reflects a growing consensus among international institutions on the importance of appropriate policy, legal, and regulatory frameworks to the development process. The World Bank, in fact, has recently codified its views in a policy paper, *The World Bank's Role in the Electric Power Sector: Policies for Effective Institutional, Regulatory, and Financial Reform,* for which the Core Report served as an input.

Richard Stern
Director
Industry and Energy Department

Abstract

This volume presents the issues and recommendations that emerged from the Electric Power Utility Efficiency Improvement Study conducted by the World Bank and nine other international technical and financial assistance organizations during 1989-91. The main report, detailing investigations of diesel power plants in 17 developing countries, was published as "Core Report of the Electric Power Utility Efficiency Improvement Study" (Industry and Energy Department Working Paper, Energy Series Paper No. 46, September 1991). The present volume extracts from the main study a set of efficiency guidelines for power utility planners and policymakers emphasizing the objectives of developing the power sector (including appropriate demand-side management) while sustaining the financial/commercial viability of the utilities; rationalizing the organizational and fiscal interactions between utilities and governments; enhancing the utilities' institutional capacity for governance and staff management; structuring utility organizations for operational efficiency; and coordinating utility activities with financing agencies' policies and procedures. A checklist, presented as an annex, provides point-by-point review of quantitative and qualitative factors that can be used to rate the performance of a utility. Quantitative measures are accompanied by target values where appropriate.

Acknowledgments

The underlying study on which this issues and recommendations volume is based was conceived by the World Bank's Energy Development Division in collaboration with the other international sponsors of the effort. Gunter Schramm, the division chief at the time, was the overall coordinator. Messrs. Arno Tomowski of GTZ in Germany and Granville (Pete) Smith of USAID were the study team's managers during the two years of investigative and analytical work. Both also participated in or led a number of the field studies. Mr. Christoph Menke was the manager during the final stage, supported part time by Mr. P. Gregory Fazzari. Mr. Jose R. Escay was in charge of data management for a two-year period. The team's overall efforts and large communications and filing requirements were supported by Ms. Yonica Burroughs.

Professor Erwin Diewert of the University of British Columbia, supported by his own research team, undertook the extensive econometric analysis of the collected data. His work was financially supported by the World Bank's Research Committee. Additional data sets were supplied by the Institute of Diesel and Gas Turbine Engineers. The new data made it possible to extend the econometric evaluations to a sample of close to 200 power plants. The results of this additional study will be published as a separate paper under the authorship of Professor Diewert, along with Messrs. W. Teplitz-Sembitzky and Gunter Schramm.

Particular thanks are due to the members of the Steering Committee of the Electric Power Utility Efficiency Improvement Study. The members of the committee not only guided the overall research effort closely but also spent a great deal of time and effort in formulating the content of the recommendations. Thanks are also due to the experts, too numerous to mention individually, who participated in the 17 individual country missions and who helped to collect original data from 20 others. Similarly, thanks go to Mr. Paul Wolman, who managed the editorial work on the document, and to Ms. Carole-Sue Castronuovo, who carried out the final formatting of both the manuscript and the checklist.

1

Introduction

During the past ten years, multilateral development banks have financed some US$35 billion in power projects. According to a World Bank review of lending for electric power, installed capacity grew during this period at an average annual rate of about 8 percent in 51 developing countries. But other measures of progress in the sector showed disturbing signs of inefficiency. Network energy losses and accounts receivable increased, economic rates of return declined, and debt service ratios dropped. Performance was especially poor in Africa, where many power plants required rehabilitation after just a few years of operation. This poor performance was also observed by many bilateral donor agencies.

Motivated by these disturbing findings, UNDP and the World Bank, along with financial and technical assistance agencies in Denmark, Finland, Germany, the United Kingdom, and the United States, agreed in September 1988 to fund an investigation of power sector performance. For this purpose, the Electric Power Utility Efficiency Improvement Study was organized. The study's approach and findings are described fully in the Project's Core Report, which was published as World Bank Industry and Department Energy Series Working Paper No. 46 in September 1991.

The objectives of the program were to (a) identify the causes of poor utility performance; (b) prepare remedial programs; and (c) prepare recommendations for use by financing agencies, electric utilities, and governments. These policy recommendations are intended to meet the policy aspects of objective c.

The recommendations were prepared with the understanding that their users agree on a common set of objectives in regard to power plant operation and sector development in developing countries. The objectives are as follows:

a. Aim for the least-cost solution compatible with technology appropriate for local conditions. The solution should not overlook efficiency improvements, rehabilitation, and demand-side management.

b. Build and maintain institutions capable of planning and implementing programs that guarantee the availability, efficiency, and sustainability of each power project over its designed life span.

c. Ensure the financial viability of the operating utility.

d. Ensure protection of the environment.

e. Ensure cooperation among financing agencies and the utility to achieve shared development goals.

These recommendations are designed to assist decisionmakers concerned with planning and financing power projects and with improving and sustaining efficient utility operations. These decisionmakers include the officers of utilities and institutions in developing countries, officers of multilateral and bilateral financing organizations, and technical assistance agencies.

The project chose diesel power plants as the vehicle for investigating the efficiency and performance aspects of utility operations because diesel plants are found worldwide and their performance is known to be robust and efficient with proper maintenance but to deteriorate rapidly with poor maintenance. Also, diesel power plants are generally smaller and less complex than thermal and hydro plants, both from a technical and from a management point of view; the causes of inefficiency in the operation of the utility also can be identified more easily analyzing the simpler diesel plants. It should be noted, however, that although the project focused on diesel plants, these recommendations are intended to apply generally to all types of utility plants and operations; only where specifically stated do they apply exclusively to diesel plants.

The recommendations address five groups of issues that are integral to the operation of any electric utility:

a. Power sector development objectives

b. Government-utility interactions

c. Utility management and manpower problems

d. Organizational aspects

e. Financing agencies' policies and procedures.

The recommendations do not consider environmental impacts because most developing countries and financing agencies appraise projects according to their own particular environmental criteria.

The recommendations are intended to supplement, not supersede, the rules and policies of financing organizations, such as World Bank operations directives or bilateral donors' appraisal manuals.

The recommendations suggest specific criteria for assessing the viability of a project and for defining the minimal conditions that must be met for a project to be successful.

Note that these conditions are necessary but not sufficient to ensure success. Although it is impossible to foretell whether such conditions will continue to be satisfied following plant completion, decisionmakers can usually assume with some confidence that a utility's performance, staff competence, and corporate culture will not change rapidly unless specifically forced to do so. Therefore, an examination of the record of similar plants within a utility will give a good indication of the kind of performance that can be expected.

The annex incorporates these issues into a checklist of criteria for efficient operation of utilities. By reviewing the ways in which an individual country or specific utility has handled operating issues in the past, or by examining how existing projects are performing according to the checklist, one can get a good indication of what to expect from a new project.

No recommendations can substitute for the good judgment and experience of the decisionmakers. What they can do is provide a point of reference against which decisions can be measured and against which the probability of a project's success can be systematically assessed.

2

Power Sector Development Objectives

These recommendations emphasize the organizational, institutional, and human-related aspects of utility operations. They are framed within the following objectives, which are imperative for sound power sector planning:

a. Investments in the power sector should be a vehicle for promoting economic growth and social well-being in developing countries.

b. Power sector projects must compete with other investments aimed at contributing to this overall objective and should be executed only if they prove optimal in terms of intersectoral allocation of scarce funds.

c. Investment projects must show advantages against competing projects that provide the same services, and they must result in the least lifetime-cost solution compared to other projects.

d. Projects are to be compared using a total system approach, which requires a comprehensive definition of the alternatives for system expansion.

Some of the principal issues for power sector planning are discussed below.

Electrification Policy

The most important consideration in planning power sector development should be the extent to which electrification contributes to economic growth by supporting industrial, semi-industrial, commercial, and agricultural activities in the country in question.

Rural electrification should be undertaken only if it contributes to economic growth. To contain costs, all feasible alternatives must be examined; in addition to the conventional solutions using diesel plants, or extending existing electricity grids, various forms of renewable energy should be considered. Where electricity would be used mainly for lighting or for nonproductive purposes, photovoltaic systems or even kerosene may provide a least-cost solution of adequate quality.

When a particular expansion project is not financially viable, and is likely to entail losses for the utility or for the agency that would implement it, the project should not be

undertaken unless clear and enforceable arrangements have been made to compensate for the losses. These losses could be covered by one or both of these:

a. Direct payment by the government

b. Cross-subsidies up to a certain extent; (i.e., the utility shall charge higher tariffs to certain categories of users to make up the losses).

If subsidies are granted for projects or project components that are not financially self-sustaining, transparency is essential. It should be clearly shown that a subsidy is granted, of what amount, who will pay it, what benefits are expected, and who the beneficiaries will be. Further, when the subsidy is created, a time limit should be set after which it will be abolished, either automatically or on fulfillment of certain conditions.

Long-Term Expansion Planning

Any proposed project whose capacity is large compared with overall system capacity should be undertaken only under a long-term system planning approach. This is essential to make it possible to judge the merits of a particular project compared with other alternatives.

Physical expansion of system capacity should be undertaken only when all other approaches to attaining the fixed supply level have been unsuccessful or determined to be more costly. As a rule, physical expansion is preferable only if it is infeasible or less costly to reduce demand or increase supply and available capacity through the following:

a. Demand-side conservation measures

b. Demand-side management, such as time-of-day load shifting

c. Reducing technical losses for all system components

d. Improving existing system availability, operating efficiency, and reliability

e. Rehabilitating existing physical assets.

Expansion planning should be based on well-defined availability and reliability standards. The cost of unserved energy and unreliability of supply should be balanced with the cost involved in guaranteeing a specific loss-of-load criterion. This approach may in many cases result in lower reliability standards for isolated areas, which would be balanced by lower investment and operating costs.[1]

Demand forecasts on which future expansion plans are based should not be presented as firm estimates but as a range of likely future scenarios. Particular attention

1. A separate study sponsored by the World Bank, the Asian Development Bank, the Inter-American Development Bank, and the British Overseas Development Association was undertaken by London Economics under the title "Project to Develop a Methodology for Estimating Outage Costs in Developing Countries." The findings will be published in 1994.

should be given to crucial parameters, such as changes in the overall economic rate of growth or the potential effects of needed tariff increases.

In planning the system expansion components, due attention should be given to potential risk elements on both the demand and the supply side (e.g., cost overruns). Preference should be given to plans that allow for flexibility and adaptability in response to changing conditions.

3

Government–Utility Interaction

Autonomy from government and consistency of objectives were seen in the Core Report of the Electric Power Utility Efficiency Improvement Study as keys to determining a utility's operating efficiency. This section discusses the crucial issues within that context.

Agreement on the Utility's Objectives

When governments control utilities, through ownership or otherwise, they must, as a minimum:

a. Define clear, nonconflicting objectives for the utility's performance

b. Allow the utility to operate with a high degree of autonomy

c. Allow the utility to charge adequate tariffs

d. Ensure the availability of convertible currency according to the needs of the utility

e. Refrain from interfering in staffing questions by limiting intervention to appointing competent top managers who are then held accountable for the utility's performance.

These critical conditions for government-utility interaction are discussed below.

Government and the utility must agree on the statutory and performance objectives upon which the utility can base its long-term investment planning and by which it can measure its operational performance. As a *minimum condition,* there should be agreement on a target rate of return for the utility. This rate should be calculated in *real terms,* net of nominal price increases, and should take account of exchange-rate fluctuations, revaluation of assets, and price distortions such as subsidies on fuel.

It is particularly important to ensure that the government's sectoral policy regarding new customer connections is compatible with financial cost recovery.

Financial autonomy and fuel cost recovery for the utility are fundamental objectives; to that end, the utility generally should not be given funds on preferential terms. Funds received by the government from foreign donors should be on-lent at appropriate

(commercial) market rates, with the utility in principle being obligated to bear the foreign exchange risk. Financing agencies should monitor on-lending terms for aid to the power sector, including aid provided for technical assistance. Some special exceptions may be considered for rural electrification projects, provided the conditions listed under the heading Electrification Policy in chapter 2 are fully met.

Encourage Managerial Autonomy

Concerning the level of autonomy, the Core Report found a close correlation between a utility's level of autonomy and its efficiency of performance and made two specific recommendations—namely, that financing and donor agencies should, during appraisal, (a) assess the level of autonomy of the recipient utility, and (b) if the latter is found to be low, attempt to increase the utility's autonomy before providing financing.[2]

Utility managers must have substantial control over their operations in matters concerning personnel, salaries, incentives, overall financial management, and contracts. At the same time, autonomous managers must accept full responsibility for their decisions and for overall performance. Financial and technical assistance agencies have an important role to fulfill in promoting managerial autonomy. Technical assistance agencies can provide the necessary training and expertise, and financial agencies can delay committing funds for new investments until an acceptable operating environment is in place in the utility. Disbursement of funds should be linked to the progress achieved in reducing government interference and in creating autonomous management structures.

When qualified local personnel are not available to assume increased responsibilities, other ways to increase autonomy should be sought, such as

a. Hiring expatriate personnel in line functions

b. Contracting out specific activities, such as plant maintenance or billing and collection, to qualified private firms.

The costs and benefits of such measures should be compared to find the optimal solution for each case.

Establish Adequate Tariffs and Collection Practices

Utilities cannot, and do not, operate efficiently when their revenues do not cover their costs. Generally this situation arises in one or both of these cases:

a. The government prevents the utility from charging adequate tariffs.

b. The utility is unable to collect outstanding bills in a timely manner either because of inefficiencies in the billing and collection system or because political expedience prevents the utility from forcing its customers (particularly government or government-owned entities) to pay their bills.

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2. See also "Core Report," Annex 3 to chapter 1.

In principle, tariffs should be set to achieve an economically efficient allocation of available resources. The recommendation therefore is that tariffs should reflect the long-run marginal costs (LRMC) of system expansion. Donors, the utility and government should all agree on the long-run marginal costs, and the tariff structure should be set accordingly. If LRMC pricing conflicts with other goals, such as the financial viability of the utility, or if other considerations, such as widespread price distortions, call for a modification of strict LRMC pricing, the level and structure of the tariffs should ensure that the utility as a whole achieves the target rate of return. The financial condition of individual units of a utility system can be weaker, as long as LRMC pricing applies to the utility as a whole.

Local or regional plants or distribution units that are unable to cover their own operating and maintenance costs must receive adequate financial support from the central administration. There is no compelling reason why tariffs should be the same everywhere in the country; they may differ, for instance, between interconnected and isolated systems.

No loan, credit, or aid disbursements for new projects should be made, except for direct remedial measures, unless existing tariff, billing, and collection deficiencies have been remedied. The following minimum targets should be applied:

a. Total accounts receivable from governments or government-owned entities do not exceed 2 months of billing.

b. Total accounts receivable from private customers do not exceed 3 months of billing.

c. Total losses (defined as energy sent out minus sales as a percentage of sent-out energy) do not exceed 20 percent.

d. All customers (government or private) with outstanding payments of 3 months or more have been disconnected.

Even if these minimum conditions are met, programs to reduce losses and accounts receivable should be in place before new projects are financed. Disbursements during execution could be linked to the progress achieved.

Ensure Access to Convertible Currency

Utility management must have access to convertible currency to maintain efficient operation. Diesel plants in industrialized countries required about US$16 per kilowatt a year in 1988 prices for spare parts and consumables, in addition to fuel and lube oil costs. In developing countries, utilities require about US$20 to 25 per kilowatt a year.

A major issue that must be dealt with decisively and permanently is the frequent delay in obtaining central bank or import licensing agency approvals for needed spare parts acquisitions, particularly in emergency situations. To ensure timely availability of convertible currency for spare parts acquisition, governments can make use of several mechanisms:

a. Public auctions of limited amounts of foreign exchange, and authorization for the utility to pass on increased foreign exchange costs through automatic rate increases.

b. Creation of a disposition fund as part of initial project financing. To ensure access to foreign exchange, the fund would be credited with the amount of foreign exchange contributed by the donor to finance local capital expenditures. The central bank or an offshore trustee would receive foreign exchange from the donor during the *investment phase,* with the obligation to release the funds to the utility during the *operation phase* if the need arises.

c. Authorization for the utility to charge specific customer groups (e.g., expatriates, embassies, export industries, international hotels) fully or partially in foreign exchange rather than in local currency, and to keep this foreign exchange for its own needs. These mechanisms should be seen as interim solutions until improved economic conditions and a changed monetary policy allow local currency to be converted or foreign exchange to become freely available.

The external financing agency must take into account that in countries with a chronic scarcity of foreign exchange, the ability of government to set up such mechanisms may be limited. In such a case, a project that will require substantial amounts of convertible currency for its operation should not be undertaken unless reliable access to foreign exchange can be ensured over a reasonable period of time.

Sector Organization and the Sources of Investment Capital

Electric power systems are highly capital intensive and require substantially more investment capital than a utility is able to accumulate internally. As a number of recent studies by the World Bank and others have shown, utilities are experiencing a huge financing gap that can no longer be covered by government grants and loans to the utilities based either on outside borrowings or the inflationary internal expansion of the domestic money supply.[3] Other sources of investment capital for utilities must be found. Financing options should include

a. A self-financing ratio by the utility of not less than 30 percent

b. Direct private sector participation through

   i. Partial or full privatization of the utility or certain portions of the utility

   ii. Build-Own-Operate and Transfer (BOOT) schemes

   iii. Joint ventures between public and private partners

3. World Bank, "Draft Power Sector Policy Paper," 1992 (now published as *The World Bank's Role in the Electric Power Sector: Policies for Effective Institutional, Regulatory, and Financial Reform,* Washington, D.C., 1993).

iv. Development of regulatory structures that allow privately owned co-generation plants to sell surplus power to utilities at prices that reflect the utilities' own opportunity costs of generation.

For governments and utilities to consider such options seriously, laws, rules, and regulations must be developed and put into place that encourage private sector participation in the power sector. The rules of the game should include security of tenure and rate regulations that allow private enterprises to operate profitably. Ideally, the government's role in the sector should be restricted to that of an effective regulator of economic activities in the power sector. Its contribution should be to create a suitable legislative framework and to set mandatory standards for operation and environmental protection.

4

Utility Management and Manpower Problems

Good hardware and organization are indispensable to the operation of a utility, but the quality of its staff is paramount for success. This section is concerned with management, staff, and training issues.

Enhance and Maintain Quality of Management and Staff

Autonomy, financial independence, and new or rehabilitated hardware are not enough to make a utility operate efficiently. To bring about efficient operation, it is necessary to create an environment in which qualified, competent, and dedicated management and staff work together to make long-term efficient performance the norm. To bring about the necessary corporate culture, governments must take special care to appoint competent top managers and to hold them accountable for utility performance on the basis of agreed-upon standards and objectives. The appointment of second- and lower-level managers should generally be handled by top managers who are directly responsible for their performance. For government-owned utilities, four policies should be followed:

a. Government approves the composition of the utility's governing board (which should include representatives of power consumers).

b. Government appoints the managing director of the utility upon the advice of the utility's governing board.

c. The managing director appoints the major department heads with approval of the utility's governing board.

d. To ensure continuity, the appointments should be for a minimum term of 3, but preferably for 5, years.

It may not always be possible to obtain the services of competent higher-level managers or technical experts within a country, even if employment and remuneration conditions are made highly competitive in the context of the local labor market. This problem can often be remedied in the short run by hiring expatriate advisers or managerial staff, if necessary with the assistance of outside agencies. Such arrangements are often

intended both as a stopgap and as a transition to greater reliance on local personnel after these personnel receive appropriate training. Making that transition and determining its timing and duration are important, because it takes time for remedial measures to take effect.

Other means of overcoming managerial problems could be management contracts, twinning agreements, or other technical assistance arrangements to bring in outside expertise. Privatization or out-sourcing of some activities (billing, collections, maintenance contracts) or outright privatization of the utility itself, with direct participation by competent outside utility operators, may provide additional options for overcoming management problems.

Where serious management problems exist, the design of assistance packages by outside agencies should always focus on resolving those problems first, before financing is provided for system expansion activities.

A utility's compensation structure should be commensurate with conditions in the country and the utility's needs. Salary and overall compensation packages must be competitive within a country's labor market, particularly for skilled managerial, financial, and technical staff. It is important to note, however, that simply comparing salaries with those of the private sector rarely reveals the appropriateness of compensation. Fringe benefits, security of employment, and intangible factors are also important. It should be kept in mind that total job security based on rigid civil service rules usually is counterproductive to good job performance. Compensation, particularly at the managerial level, should include tangible incentives for superior performance and clearly articulated sanctions for poor performance. Overall, a mixture of tangible and intangible incentives and benefits, such as a positive corporate culture, cohesion of the work force, and confidence of the work force in management, are most conducive to high employee morale and the successful operation of the utility.

Overstaffing, particularly in unskilled job categories, is an endemic problem in many government-owned utilities, which are often misused as state employment agencies. The study found a high correlation between the number of employee hours per megawatt-hour with efficiency, suggesting that overstaffing can significantly decrease overall plant efficiency. Not only is overstaffing financially costly to the utility, it also effectively destroys the discipline and morale of staff members who observe paid colleagues with little or nothing to do. Such overemployment practices must be strongly discouraged. Utility management must have the right to adjust the number and composition of the utility's staff according to the work load, and the right to discharge unneeded or unqualified employees according to established criteria and standards.

The utility should be organized and structured so as to clearly define the responsibilities of each staff and management position. There should be no parallel or duplicate areas of decisionmaking or responsibility. Clear communication channels should be established among different departments and between utility headquarters and external

operating units. Only then can managers be judged according to their performance and held responsible for mismanagement.

Managers and staff must be given an appropriate framework within which to work. This shall include:

a Clear corporate objectives

b. Appropriate management information and reporting systems

c. Well-defined performance indicators by which the achievement of objectives will be measured.

Corporate planning in the utility should not be restricted to the technical design of the system, but should include financial and manpower planning. Adequate accounting and budgeting procedures should be in place or be scheduled for implementation before new investments are undertaken.

Manpower Development and Training Programs

Technical competence and adequate training, as well as the constant upgrading of skills, are crucial for achieving efficient operations. The Electric Power Utility Efficiency Improvement Study has identified as a basic lesson that an institutional training program is an essential component of an efficient and sustainable power operation. Therefore, each utility must have a long-term manpower development and training program. Where such a program does not exist or is found to be inadequate, it should be developed. It should also be an integral part of any new project. The program should include institutionalized training schemes, and may also include the development of detailed job descriptions and career-oriented promotion schemes. Recruitment and promotion should be based on job qualification and performance rather than on other, less objective criteria.

Manpower development must assess training needs. In addition to the training of technical staff, the assessment should cover training in managerial and commercial operations and in accounting. Classroom training, on-the-job training, manufacturer's training, unstructured hands-on training by technical assistance personnel, training based on suitable educational media, or some combination of these are all useful and appropriate.

There is no single way to meet all training needs. Approaches can be combined depending on specific conditions. Like technical assistance, training should not be seen as a one-shot affair, but rather as an ongoing process. The cost of training must form an integral part of the utility's recoverable cost base. A comprehensive analysis of training needs should be prerequisite for any power project, and outside technical assistance may be needed to ensure long-term success.

Training needs for newly recruited personnel may differ according to the quality of the general education system of the country. Unless there is a vocational school in the country, the utility will have to run its own training program to produce skilled staff. Short-term, one-of-a-kind programs are likely to be ineffective, especially if the courses are given overseas under conditions different from those of the developing country. Short-

term refresher courses for qualified and experienced personnel, however, can be valuable. For technical staff, refresher courses can be combined with technical assistance from the manufacturer's staff during major overhauls.

5

Organizational Aspects

This section will identify ways in which distinct institutional arrangements between a plant and a utility can affect a plant's operational efficiency and sustainability.

Budget Centers and Allocation of Adequate Funds

Isolated diesel plants or comparable operating units should be managed as separate budget centers that are autonomous in operation. The operating unit should have sufficient funds at its disposal to cover its cash operating costs, and appropriate cost accounting, budgeting, and auditing procedures should be in place or in the process of being put in place.

Funds should be made available to the operating unit from the revenues accruing from operation—that is, only surplus revenues over operating costs should be channeled back to utility headquarters. Misappropriation of funds should be prevented by appropriate auditing and supervisory arrangements. Where locally collected funds are insufficient to cover operating and maintenance costs, additional funds must be provided by headquarters. Locally collected funds will always be insufficient in utilities with centralized billing and collection systems, and frequently in systems that apply country-wide uniform tariff structures that do not take into account differences in local costs.

Procurement of major inputs to the operation, such as fuel, lubricants, and spare parts can be handled centrally and distributed from headquarters, but all purchases of material needed for daily operation should be managed by the plant.

Maintenance of Adequate Communication Channels

The management principles and organizational criteria that apply to the utility as a whole apply at the plant level as well. Because isolated plants are often located in remote areas, there must be a clearly defined organizational set-up and an institutionalized communication system. Wherever the operating units are located, they require timely and adequate supplies of fuels and spares. Similarly, headquarters requires a flow of data on technical and commercial operations from the plant, as well as a transfer of funds if the

plant generates a surplus from operation. Frequent and cordial interaction between plants and headquarters is essential; a lack of information exchange can easily impair plant performance.

Plant operating data, inputs, and outputs must be recorded and processed to produce quantitative measures of performance. This data should be standardized to allow a comparison with data of other operating units inside and outside the utility.[4] Comparative data should be communicated to plant managers and used for setting performance targets and for medium-term budget planning. The processing and exchange of data are necessary to enhance the plant manager's and the staff's understanding of the rationality of the standards by which they are being measured.

The existence and appropriateness of plant-headquarters interactions can be judged by the following principles:

a. There should be *one* division or staff position at headquarters responsible for supervising operations in outlying areas; the responsibility should not be shared by several units or delegated to subordinate levels. The responsible party should report directly to the general manager of the utility.

b. There should be regular meetings between headquarters representatives and plant managers; the utility's budget should provide adequately for travel expenses for such meetings.

c. There should be institutionalized communication links, such as circular letters.

d. Reports from plant managers should follow a standardized format that addresses all important aspects of the plant's performance: operation, production record, maintenance activities, accidents, outages, voltage fluctuations, equipment failures, financial cost accounting, revenue collections, and staffing issues.

e. Reports from plant managers should be written in such a way that the information they contain can be readily processed and analyzed by their supervisors.

f. Plant managers should receive prompt feedback on their reports and should be assisted by visiting specialists from headquarters in resolving technical, commercial operation, and staffing problems.

Donors should assess compliance with these principles at the appraisal stage.

Equipment Standardization

Most power generating plants, particularly those based on diesel engines, require that a relatively large number of spare parts be available for both regular and emergency maintenance work. This work is made more difficult if different makes or types of engines are installed at the same plant, because a wider variety of parts must be kept on hand and

4. A checklist of performance data is given as an annex.

because the staff must be trained to work on different machines. As the study has found, these differences in the majority of cases significantly increase a plant's overall operating and maintenance costs, and can also reduce unit availability. Standardizing a plant with the engines of one manufacturer, or at least with engines of the same type, offers substantial benefits in the long run, although a decision to standardize could reduce the economic benefits of international competitive bidding. To avoid the drawbacks of a quasi-monopolistic situation, a reasonable policy might be to restrict tenders to an appropriate number of suppliers, even though doing so might run contrary to the immediate interests of donors and of suppliers who are excluded from bidding.

Provision of Adequate Spares and Supplies

Reliable provision of spares and supplies is essential for reliable operation. A scarcity of foreign exchange is bound to create serious problems in this regard, especially if it is compounded by inefficient procurement, delivery, and stores systems within the utility.

To reduce the probability and duration of breakdowns and outages caused by lack of spares, the utility can

a. Stock more spares than needed under normal conditions: this raises costs, may create storage problems in terms of space and degradation of spares, and may not guarantee that the appropriate parts are on hand when needed.

b. Conclude special arrangements with suppliers to provide technical assistance and spares in case of emergency: this presupposes that spares procurement is an internal problem of the utility and that foreign exchange is available.

c. Create foreign exchange disposition funds: this may circumvent the problems of scarce convertible currency and slack internal procurement routines.

The actual approach will be contingent on the specific bottlenecks identified in spare parts supply. Technical assistance should be considered to assist the utility in assessing spare parts requirements and to support procurement. A combination of technical assistance and financial support is usually more successful than partial actions.

An integral part of any spare parts management policy is adequate and secure storage and proper inventory control. Outside assistance may be needed to establish such systems.

Need for Regular Servicing

Similar considerations apply to servicing. Inspection visits by factory servicemen are advisable for major overhauls every one or two years or when an accident has occurred. For these visits, foreign currency and a stock of spare parts are required. If funds for servicing and parts are not available when needed, the equipment will stay out of service. In addition, equipment operating and maintenance manuals and other important technical data should be available to plant employees in a language they understand.

Serious consideration should be given to entering into long-term service and maintenance contracts with equipment manufacturers or specialized service companies. Such arrangements are already quite common in developed countries.

Need for Consistent Fuel Supply

It is normally the responsibility of utility headquarters to ensure that fuel reaches the plant. In cases of shortages of (usually imported) fuel, the quantities sent to an isolated plant may be curtailed or suffer some shrinkage, usually in transit. Fuel might also disappear at the plant. Under such conditions, the performance of the plant is bound to be poor. An efficient procurement and control system must be established and maintained to guarantee sufficient supply of fuel and other consumables in quantitative and qualitative terms.

In countries in which availability of imported fuel supplies is a recurrent problem, serious consideration should be given to whether the construction of a heavily import-fuel dependent plant is the most suitable option. For this option to be feasible, additional foreign exchange resources may have to be made available by outside financing agencies to ensure adequate fuel supplies on a long-term basis.

Handling of Liquid Effluent

The disposal of spent lubricating oil can cause localized but acute problems if not handled properly. The same applies to fuel leaks and to the disposal of the residues from fuel centrifuges of heavy fuel plants. The available options for safe disposal, such as the use of incinerators, recycling for other uses, or intermediate storage and central collection for disposal elsewhere, should be evaluated, and the disposal technique most appropriate for the site should be adopted together with necessary monitoring procedures.

6

Financing Agencies' Policies and Procedures

The objective of these recommendations is to assist decisionmakers, and to complement the existing directives and policies of each contributing institution. This section reviews the recommendations presented, and discusses their implications for the interaction between financing agencies and the recipient utility.

The major objective of financing agencies' assistance to developing country power sectors is to bring about overall economic development and growth through the financing of new power projects. The results of the Electric Power Utility Efficiency Improvement Study and other evaluations have shown, however, that the financing agencies' traditional reliance on economic, technical, and financial evaluations of new investments (supplemented lately by environmental assessments) are not enough to ensure the success of such investments, because the underlying assumptions about the future operational performance of these new electric power projects frequently turn out to be wrong.

As the present study has shown, the major causes of economically wasteful utility performance in many developing countries are poor governance and inadequate institutional and management structures and arrangements, usually combined with inadequate revenue flows and a lack of timely access to foreign exchange. The most critical factors affecting sustainability and successful operation of utilities are as follows:

a. Autonomy of the operating institution

b. Clear, nonconflicting goals shared by the utility and the supervising body

c. Good top management

d. Adequate human resources

e. Institutionalized and effective training

f. Adequate technical resources

g. Access to foreign exchange

h. Financial transparency

i. Sufficient revenues

j. Appropriate financing agencies' policies.

The study has concluded that these factors must be satisfactorily addressed (as discussed in the previous sections) and that all necessary changes must be brought about, if new investments and financial assistance strategies are to succeed in achieving the desired objectives. Therefore, these recommendations advise that ex ante agreements should be reached among financing agencies, governments, and utilities to remedy the identified shortcomings.

To assess whether such changes are required as a precondition for planning or financial support, the past and current operational performance of the utility must be evaluated. The various issues and conditions involved in evaluating utility performance have been discussed in the previous sections of these recommendations. A short checklist of assessment criteria is attached as an annex. It must be noted that these criteria are necessary but not always sufficient to ensure a project's success. These criteria supplement those mentioned in chapter 1.

The question of the operational sustainability of a project or series of projects over its designed lifetime must be central to any planning and assistance strategy. A life-cycle approach must be used for this purpose. Where severe foreign exchange difficulties are anticipated, outside financing agencies should not support a project until more conducive economic conditions have been created. Otherwise the expected performance of the project is unlikely to materialize.

On-lending terms for aid or subsidized loans, including those for technical aid, should be monitored to meet the conditionality of full (commercial) cost recovery.

Agreement among government, the utility, and donors should be reached on the procedures for calculating and updating long-run marginal costs, so that they can serve as a basis for establishing and maintaining cost-recovering tariffs.

Power sector projects should be appraised realistically. Projects should not be undertaken if they do not prove efficient in terms of intersectoral allocation of scarce funds and if they do not represent the least-cost solution.

A condition of aid should be that management information systems be established so performance objectives can be set and progress toward them monitored.

Planning of new system components should be undertaken in close cooperation with utility staff as well as with local groups affected by the operation of the planned facility.

Insistence on competitive bidding should be softened if the negative impacts on the standardization of equipment outweighs the cost reduction achieved by open tendering. Likewise, tied-aid financing should not be imposed if it entails diversification of the equipment at a power plant.

Duplication of efforts by different donors should be avoided by coordinating the programs of all donors in a recipient country.

Agreement should be reached among governments, utilities, and all donors on the imposition of conditionalities prior to funding power projects. Responses to breaches in conditionality should be coordinated among the donors.

In general, in systems with poor operational performance and inadequately performing plants and equipment, assistance measures should initially emphasize remedial action and rehabilitation of existing plant and equipment, before new system components are financed (subject, of course, to alternative cost evaluation criteria).

If all the conditions identified in these recommendations cannot be met, judgments will have to be made whether to proceed with a new support activity. If a significant number of conditions are not met, the chances that a project will succeed are very limited. In general, where serious deficiencies are identified in one or several categories, technical or other types of assistance should be provided to remedy these shortcomings before new projects are financed. Assistance should not be provided to utilities that do not meet the revenue and self-financing objectives identified in these recommendations. Agreed-upon tariff rules must provide for the automatic pass-through of costs determined by forces beyond the control of the utility (e.g., foreign exchange rates, mandated wage rates, local inflation rates).

Donors should be wary of over-optimism in the economic appraisal, especially in forecasting demand, loss reduction, and improved financial performance. Full sensitivity analysis and assessment of financial and technical risks should be incorporated, and general preference should be given to alternatives that are less risky, have shorter gestation periods, and allow greater flexibility in implementation.

Annex

Checklist for Improving Electric Power Utility Efficiency

Contents

For copies of the checklist alone, write to:

World Bank Industry and Energy Department
Joint Energy File Room G5-100
1818 H Street N.W.
Washington, DC 20433
Phone: (202) 473-3616

Checklist for Improving Electric Power Utility Efficiency

Policy guidelines for improving the efficiency of electric power utilities prepared by the Steering Committee of the Electric Power Utility Efficiency Improvement Study (EPUES)

Instructions for use of the checklist

The checklist summarizes some of the most crucial factors that could be used to rate the past performance of a utility. These factors fall into two categories:

- Qualitative factors to which no numerical values can be assigned
- Quantitative factors that are measured on a numerical scale and for which a target value can be given.

For qualitative factors, performance can be rated on an ordinal scale of five categories ranging from "good" to "bad" (respectively from "yes" via "partly" to "no" in the case of dichotomous criteria). For quantitative factors, the performance can be rated on this same scale and in some cases in comparison to the target values provided.

Thus, the overall performance can be conveniently visualized. Although this approach does not provide an unambiguous rating of the utility's performance, it conveys a general overview of the areas where the utility fares well and where it may require improvements.

The factors to be assessed in this checklist are those that refer to the electricity business. When utilities handle other businesses as well, such as gas, water, or telephones, care must be taken to segregate the electrical business from the others.

Note:
The numerical target values given are designed to be applicable universally. They do not present "best practice" values but rather minimum acceptable conditions that should only be relaxed under very special circumstances.

Checklist

Level of autonomy	*Performance rating scale*				
	Good (Yes)	<<<<	*Medium* (Partly)	>>>>	*Bad* (No)
Qualitative indicators					
1. Does the utility have clear and consistent objectives?					
a. Are the long-term corporate objectives clearly established?					
b. Are they likely to ensure adequate operational and financial performance?					
c. Has management sufficient autonomy to operate the utility according to corporate objectives?					
2. Are daily operations of the utility insulated from external political pressure?					
3. Has management the right to hire and fire employees and to negotiate conditions of employment?					
4. Does the utility control its employees' salaries?					
5. Has the utility the right to adjust tariffs according to costs to produce sufficient revenues?					
6. Does the utility have timely access to sufficient foreign exchange?					

Top management	Performance rating scale				
	Good (Yes)	<<<<	Medium (Partly)	>>>>	Bad (No)
Qualitative indicators					
1. Is there a department in charge of corporate planning?					
2. Are there appropriate and consistent annual operating objectives?					
3. Is there an appropriate management information and reporting system?					
4. Is there a system of appropriate performance indicators to measure achievement of objectives?					
5. Are operational and performance reports processed and analyzed properly?					
6. Are there clear communication channels between upper and lower management levels?					
7. Are budgetary procedures and corporate planning coordinated properly?					
8. Is there continuous and adequate monitoring of ongoing projects?					
9. Are there action plans to remedy shortcomings?					
10. Is management held accountable for its performance?					

Human resources: Manpower planning and incentive measures	*Performance rating scale*				
	Good (Yes)	*<<<<*	*Medium* (Partly)	*>>>>*	*Bad* (No)
Qualitative indicators					
1. Is there a system of performance-based incentives in place?					
If yes, is this system in line with the social environment?					
2. Is the remuneration commensurate with that in other sectors of the economy?					
If no, do the fringe benefits (housing, family contributions, etc.) make up for the difference?					
3. Is the utility's training program judged to be adequate?					
The assessment could be based on the following factors: a. Are sufficient resources devoted to training?					
b. Is the time spent on training measures adequate?					
c. Is the training structured?					
d. Are there qualified and motivated trainers?					
e. Are there adequate incentives for staff to participate in training measures?					

Human resources: Manpower planning and incentive measures	*Performance rating scale*					*Target value*
	Good (Yes)	<<<<	*Medium* (Partly)	>>>>	*Bad* (No)	
Quantitative indicators						
1. Turnover of manpower per year as a percentage of average work force						< 10%
2. Rate of absenteeism						
3. Staff vacancies by employee classification (in particular with regard to skilled jobs) .						
4. Comparative salary and compensation levels						
5. Share of unskilled workers in the total work force						≤ 30%
6. Training costs by employees and by qualification level						
7. Number of employees per megawatt-hour sold						

Commercial operation and accounting	Performance rating scale					Target value
	Good (Yes)	<<<<	Medium (Partly)	>>>>	Bad (No)	
Qualitative indicators						
1. Overdue accounts:						
a. Are surcharges applied for overdue accounts?						
b. Is there a firm and enforced disconnection policy in place for nonpayment?						
c. Are there extra fees for reconnection?						
Quantitative indicators						
1. Outstanding accounts receivable (in months of billing):						
a. Private customers						≤ 3 months
b. Government and government-owned customers						< 2 months
2. Accounts receivable older than three months of total accounts receivable						≤ 20%
3. Bad debts (unpaid energy) as a percentage of accounts receivable						≤ 10%
4. Billing lag						≤ 30 days
5. Variance between planned budget and actual expenditures						
6. Number of customers per utility employee						
7. Salaries per utility employee						
8. Lags in providing service connection						

Financial performance	Performance rating scale					Target value
	Good (Yes)	<<<<	Medium (Partly)	>>>>	Bad (No)	
Quantitative indicators						
1. Rate of return on revalued net fixed assets (after consideration of exchange rate fluctuations)						≥ 8%
2. Average revenues from electricity sales						≥ LRMC
3. Debt service coverage of net revenues						≥ 1.5
4. Cash generation as percentage of investment expenditures (self-funding ratio)						≥ 30%
5. Debt-equity ratio						≤ 2.5

Technical performance and maintenance	Performance rating scale					Target value
	Good (Yes)	<<<<	Medium (Partly)	>>>>	Bad (No)	
Qualitative indicators						
1. Are there appropriate procedures to check the quality of fuel and lubricants?						
2. Is maintenance performed according to set schedules?						
3. Is dispatch performance optimized?						
Quantitative indicators						
1. Reliability of power system:						
a. equivalent forced outage rate						
b. spinning reserve						
2. System unserved energy						≤1%
3. Reserve margin (available capacity/peak demand)						≤1.25
4. Planned outage rate						
5. Time availability of plant per year (hours per year/8760)						≥75%
6. Fuel and lube oil consumption of thermal plants compared to manufacturer's standard						≤110%
7. System fuel cost						

(**Quantitative indicators** *continued on next page*)

Technical performance and maintenance	Performance rating scale					Target value
	Good (Yes)	<<<<	Medium (Partly)	>>>>	Bad (No)	
Quantitative indicators *(continued from previous page)*						
8. System cost of energy delivered						
9. Staff years per MWh generated						
10. System load factor						0.45-0.75
11. System losses (transmission, distribution)						≤20%
12. Technical system losses (if grid configuration allows)						≤15%
13. Station service and own use (kilowatt-hours used per kilowatt-hour generated)						≤5%
14. Nontechnical losses						
15. Thermal (diesel) generation cost in US$ per kilowatt-hour						
16. Lifetime of diesel engines (in hours)						≥75,000

Supply and materials management *(Inventory control, stores control, purchasing, and transportation)*	*Performance rating scale*					*Target value*
	Good (Yes)	<<<<	*Medium* (Partly)	>>>>	*Bad* (No)	
Qualitative indicators						
1. Are there appropriate inventory control and order policies?						
2. Is there a reliable fuel supply?						
Quantitative indicators						
1. Percentage of inventory scrapped						
2. Percentage of inventory stolen						
3. Procurement procedures:						
a. Average time from placing of order to receipt of material						
4. Inventory turnover in months						

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